EXHIBIT 4

Data-Over-Cable Service Interface Specifications DOCSIS® 3.1

MAC and Upper Layer Protocols Interface Specification

CM-SP-MULPIv3.1-I03-140610

ISSUED

Notice

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Document Status Sheet

Document Control Number	CM-SP-MULPIv3.1-I03-140610			
Document Title	MAC and Upper Layer Protocols Interface Specification			
Revision History	I01 – Released 10/29/13 I02 – Released 03/20/14 I03 – Released 06/10/14			
Date	June 10, 2014			
Status	~~Work in Progress~~	~~Draft~~	**Issued**	~~Closed~~
Distribution Restrictions	~~Author Only~~	~~CL/Member~~	~~CL/ Member/ Vendor~~	**Public**

Key to Document Status Codes

Work in Progress	An incomplete document, designed to guide discussion and generate feedback that may include several alternative requirements for consideration.
Draft	A document in specification format considered largely complete, but lacking review by Members and vendors. Drafts are susceptible to substantial change during the review process.
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Closed	A static document, reviewed, tested, validated, and closed to further engineering change requests to the specification through CableLabs.

Trademarks

1.2.2 DOCSIS Network and System Architecture

The elements that participate in the provisioning of DOCSIS services are shown in Figure 1-1.

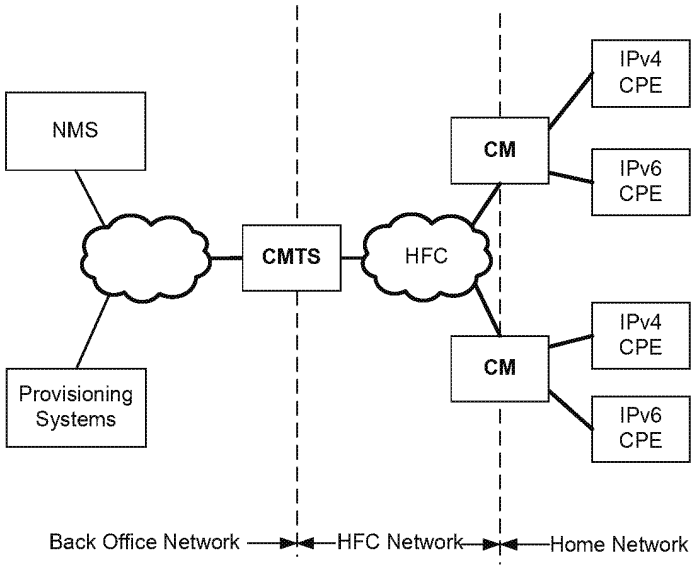

Figure 1-1 - The DOCSIS Network

The CM connects to the operator's HFC network and to a home network, bridging packets between them. Many CPE devices can connect to the CM's LAN interfaces, can be embedded with the CM in a single device, or they can be separate standalone devices (as shown in Figure 1-1). CPE devices may use IPv4, IPv6 or both forms of IP addressing. Examples of typical CPE devices are home routers, set-top devices, personal computers, etc.

The CMTS connects the operator's back office and core network with the HFC network. Its main function is to forward packets between these two domains, and optionally forward packets between upstream and downstream channels on the HFC network. The CMTS performs this forwarding with any combination of link-layer (bridging) and network-layer (routing) semantics.

Various applications are used to provide back office configuration and other support to the devices on the DOCSIS network. These applications use IPv4 and/or IPv6 as appropriate to the particular operator's deployment. The following applications include:

Provisioning Systems:

- The DHCP servers provide the CM with initial configuration information, including the device IP address(es), when the CM boots.
- The Configuration File server is used to download configuration files to CMs when they boot. Configuration files are in binary format and permit the configuration of the CM's parameters.
- The Software Download server is used to download software upgrades to the CM.
- The Time Protocol server provides Time Protocol clients, typically CMs, with the current time of day.
- Certificate Revocation server provides certificate status.

Network Management System (NMS):

- The SNMP Manager allows the operator to configure and monitor SNMP Agents, typically the CM and the CMTS.
- The syslog server collects messages pertaining to the operation of devices.
- The IPDR Collector server allows the operator to collect bulk statistics in an efficient manner.

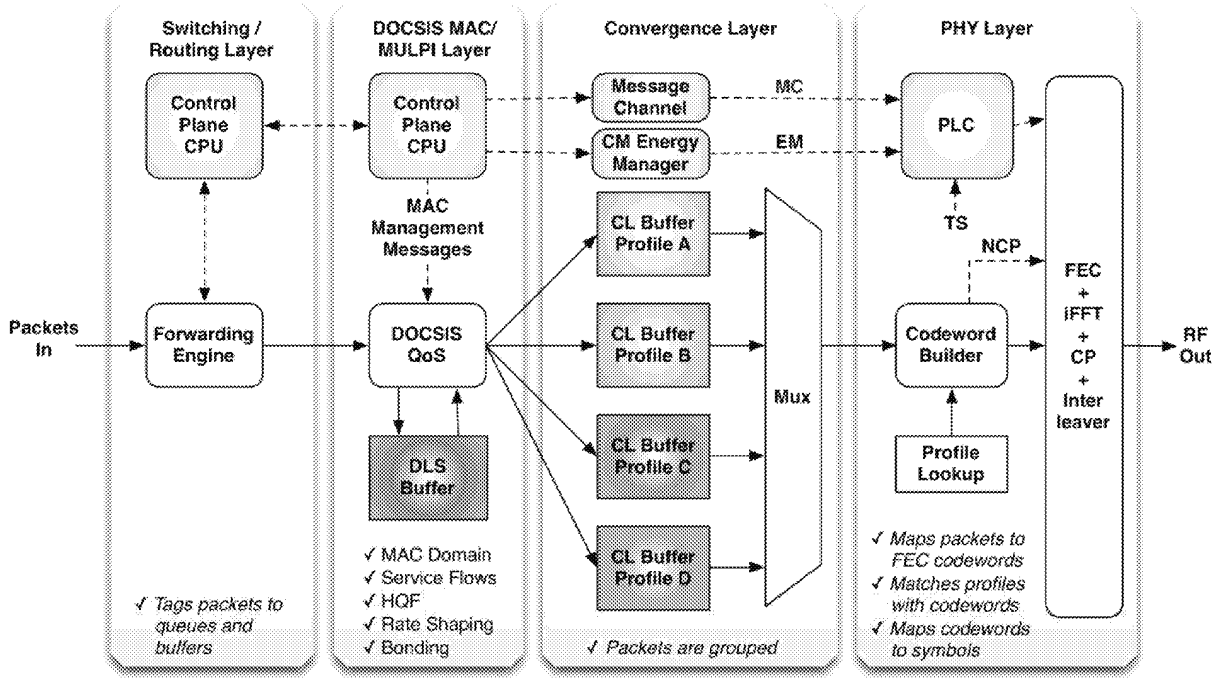

Figure 5-5 - Downstream Convergence Layer Block Diagram

5.2.3 OFDMA Upstream

OFDMA is a new type of upstream channel for DOCSIS 3.1. OFDMA upstream channels can span more spectrum than TDMA or S-CDMA upstream channels. OFDMA upstream channels use LDPC for Forward Error Correction and have other attributes specific to Orthogonal Frequency Division Multiplexing technology. OFDMA channels utilize a framing structure consisting of a number of symbols in time and a number of subcarriers in frequency. Some of the subcarriers are excluded and never used on the channel. Other subcarriers are not used for transporting MAC-layer data but are used for physical layer monitoring. Subcarriers used for transporting MAC-layer data are grouped in sets of 8 (50 kHz subcarrier spacing) or 16 (25 kHz subcarrier spacing) contiguous subcarriers in the frequency dimension and K symbols in the time dimension to create minislots in a frame structure.

On TDMA and S-CDMA upstream channels with Multiple Transmit Channel Mode, the CMTS can create 5 profiles that are used for data transmissions. These profiles define the modulation rate and Reed-Solomon codeword size to be used any time a transmission is made with that profile. With OFDMA upstream channels, the LDPC codeword sizes are fixed. For OFDMA channels, the number of data profiles is expanded to 7 and the profile describes the modulation rate and pilot pattern on a minislot by minislot basis for a frame. Thus, a single OFDMA data profile can use different modulation rates for different minislots within a frame.

For TDMA and S-CDMA upstream channels, a ranging burst uses all of the spectrum defined for the channel and is used to adjust a CM's transmit timing, power, and pre-equalization. With OFDMA upstream channels, ranging uses a subset of the spectrum defined for the channel. In order to properly adjust the CM's transmit pre-equalizer for every non-excluded subcarrier, the CMTS needs to receive a transmission with a known pattern on every non-excluded subcarrier. For OFDMA upstream channels, this known pattern is provided by probing. A probe is a wide-band physical-layer signal that the CM sends in response to a special probe bandwidth allocation. Probing is used whenever the CMTS needs to evaluate the CM's transmit pre-equalization.

5.2.4 QoS

This section provides an overview of the QoS protocol mechanisms and their part in providing end-to-end QoS.

Some of the Quality of Service related features described in this specification include:

- Packet Classification and Flow Identification